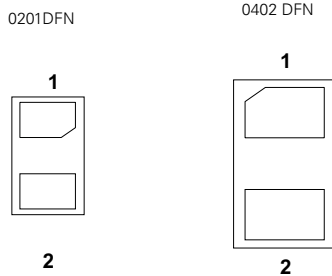


## SESD Series Ultra Low Capacitance Discrete TVS



### Pinout



Bottom View

### Functional Block Diagram



**Unidirectional**

**Bidirectional**

### Description

The SESD Series Ultra Low Capacitance Discrete TVS provides unidirectional and bidirectional ESD protection for the most challenging high speed serial interfaces. Its low off-state capacitance, extremely low leakage (< 50 nA) and low dynamic resistance make it compatible with high speed signaling such as USB 3.1, HDMI 2.0, DisplayPort, and V-by-One®.

The SESD series has an ESD (IEC 61000-4-2) rating of  $\pm 20$  kV packaged in the industry's popular 0402 and 0201 footprints.

### Features

- 0.13pF MAX bidirectional off-state capacitance
- 0.25pF MAX unidirectional off-state capacitance
- IEC 61000-4-2 ESD rating of  $\pm 20$  kV air and contact discharge
- Low clamping voltage of 10V @ IPP=2A (Bidirectional) (tP=8/20 $\mu$ s)
- PPAP capable
- Low profile 0201 and 0402 DFN packages
- Facilitates excellent signal integrity
- ELV-Compliant
- RoHS-Compliant and Lead-Free

### Applications

- Ultra-high speed data lines
- USB 3.1, 3.0, 2.0
- HDMI 2.0, 1.4a, 1.3
- DisplayPort™
- Thunderbolt (Light Peak)
- V-by-One®
- LVDS interfaces
- Consumer, mobile and portable electronics
- Tablet PC and external storage with high speed interfaces
- Applications requiring high ESD performance in small packages

## Absolute Maximum Ratings

| Symbol     | Parameter                        | Value      | Units |
|------------|----------------------------------|------------|-------|
| $I_{PP}$   | Peak Current ( $t_p=8/20\mu s$ ) | 2.0        | A     |
| $T_{OP}$   | Operating Temperature            | -55 to 125 | °C    |
| $T_{STOR}$ | Storage Temperature              | -55 to 150 | °C    |

**CAUTION:** Stresses above those listed in "Absolute Maximum Ratings" may cause permanent damage to the component. This is a stress only rating and operation of the component at these or any other conditions above those indicated in the operational sections of this specification is not implied.

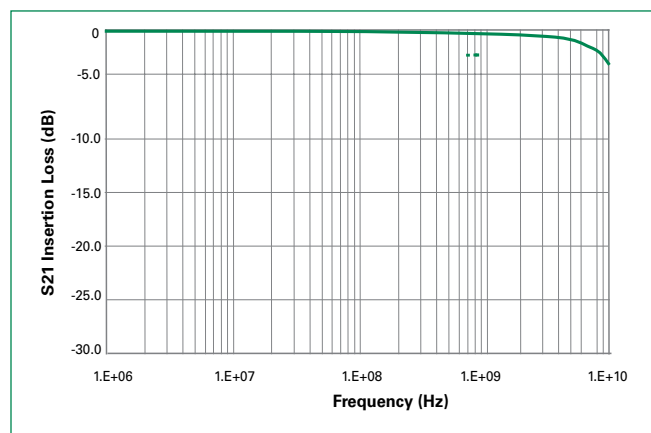
## Unidirectional Electrical Characteristics - ( $T_{OP}=25^{\circ}C$ )

| Parameter               | Test Conditions             | Min      | Typ  | Max  | Units |
|-------------------------|-----------------------------|----------|------|------|-------|
| Input Capacitance       | Reverse Bias=0V, $f = 3GHz$ | -        | 0.20 | 0.25 | pF    |
| Breakdown Voltage       | $V_{BR} @ I_T=1mA$          | -        | 9.00 | -    | V     |
| Reverse Working Voltage | -                           | -        | -    | 7.0  | V     |
| Reverse Leakage Current | $I_L @ V_{RWM}=5.0V$        | -        | 25   | 50   | nA    |
| Clamping Voltage        | $V_{CL} @ I_{PP}=2.0A$      | -        | 9.20 | -    | V     |
| ESD Withstand Voltage   | IEC 61000-4-2 (Contact)     | $\pm 20$ | -    | -    | kV    |
|                         | IEC 61000-4-2 (Air)         | $\pm 20$ | -    | -    |       |

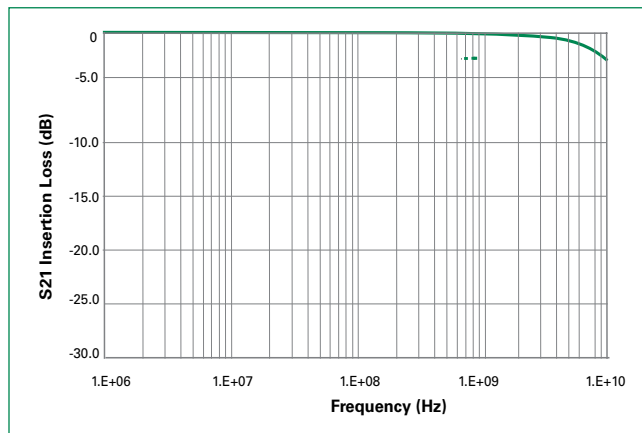
## Bidirectional Electrical Characteristics - ( $T_{OP}=25^{\circ}C$ )

| Parameter               | Test Conditions             | Min      | Typ  | Max  | Units |
|-------------------------|-----------------------------|----------|------|------|-------|
| Input Capacitance       | Reverse Bias=0V, $f = 3GHz$ | -        | 0.10 | 0.13 | pF    |
| Breakdown Voltage       | $V_{BR} @ I_T=1mA$          | -        | 9.80 | -    | V     |
| Reverse Working Voltage | -                           | -        | -    | 7.0  | V     |
| Reverse Leakage Current | $I_L @ V_{RWM}=5.0V$        | -        | 25   | 50   | nA    |
| Clamping Voltage        | $V_{CL} @ I_{PP}=2.0A$      | -        | 10.0 | -    | V     |
| ESD Withstand Voltage   | IEC 61000-4-2 (Contact)     | $\pm 20$ | -    | -    | kV    |
|                         | IEC 61000-4-2 (Air)         | $\pm 20$ | -    | -    |       |

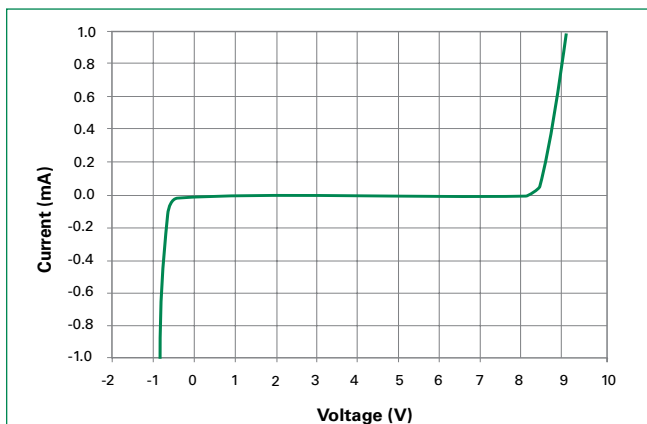
## Insertion Loss Diagram - Unidirectional



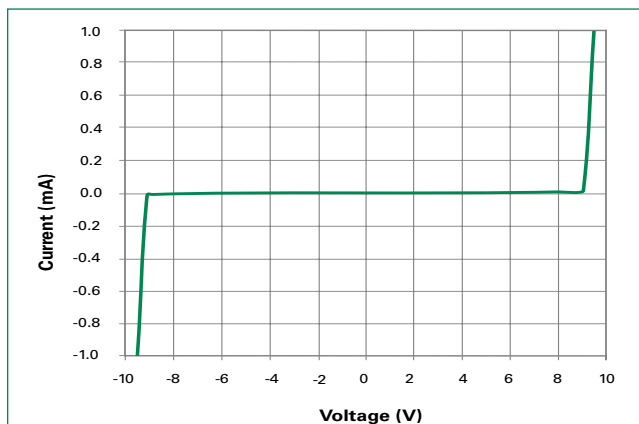
## Insertion Loss Diagram - Bidirectional



### Component IV Curve - Unidirectional

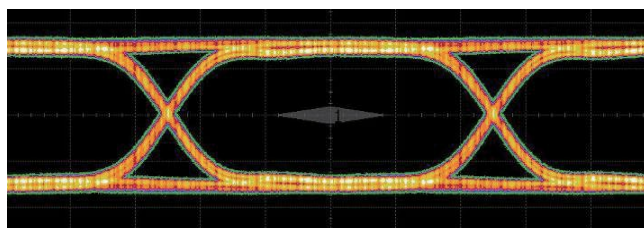


### Component IV Curve - Bidirectional

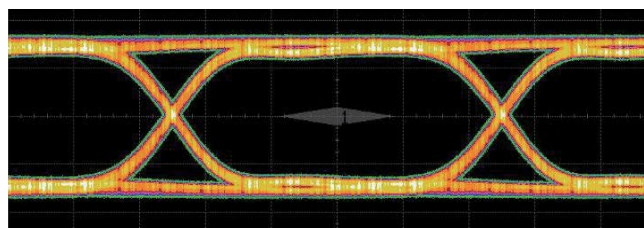


### USB3.0 Eye Diagram

5.0 Gb/s, 1000mV differential, CPO Compliant Test Pattern



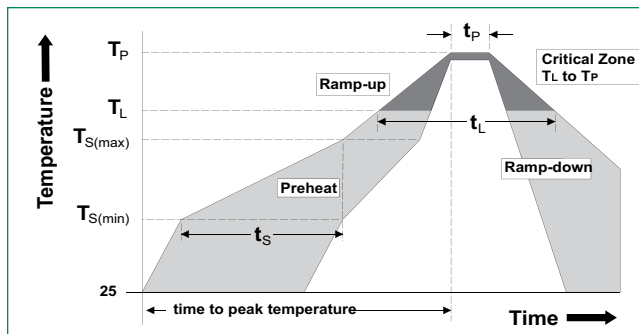
Without SESD Device



With SESD Device

### Soldering Parameters

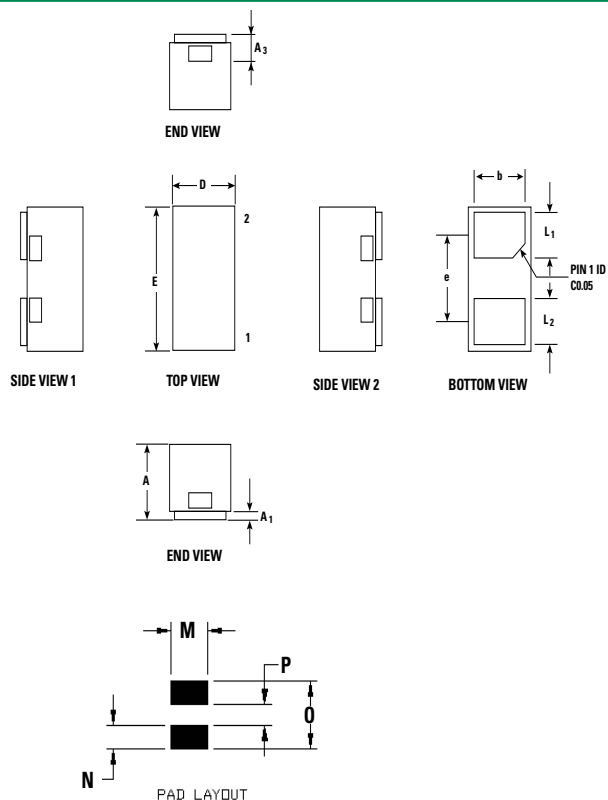
| Reflow Condition                                       |                                    | Pb – Free assembly      |
|--------------------------------------------------------|------------------------------------|-------------------------|
| Pre Heat                                               | - Temperature Min ( $T_{s(min)}$ ) | 150°C                   |
|                                                        | - Temperature Max ( $T_{s(max)}$ ) | 200°C                   |
|                                                        | - Time (min to max) ( $t_s$ )      | 60 – 180 secs           |
| Average ramp up rate (Liquidus) Temp ( $T_L$ ) to peak |                                    | 3°C/second max          |
| $T_{s(max)}$ to $T_L$ - Ramp-up Rate                   |                                    | 3°C/second max          |
| Reflow                                                 | - Temperature ( $T_L$ ) (Liquidus) | 217°C                   |
|                                                        | - Temperature ( $t_L$ )            | 60 – 150 seconds        |
| Peak Temperature ( $T_p$ )                             |                                    | 260 <sup>+0/-5</sup> °C |
| Time within 5°C of actual peak Temperature ( $t_p$ )   |                                    | 20 – 40 seconds         |
| Ramp-down Rate                                         |                                    | 6°C/second max          |
| Time 25°C to peak Temperature ( $T_p$ )                |                                    | 8 minutes Max.          |
| Do not exceed                                          |                                    | 260°C                   |



### Product Characteristics

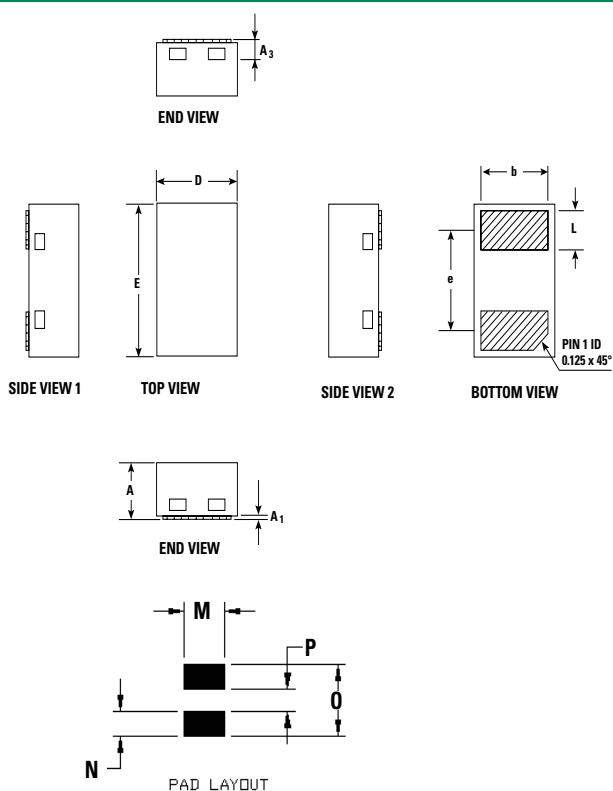
|                    |                                                        |
|--------------------|--------------------------------------------------------|
| Lead Plating       | Pre-Plated Frame                                       |
| Lead Material      | Copper Alloy                                           |
| Substrate material | Silicon                                                |
| Body Material      | Molded Compound                                        |
| Flammability       | UL Recognized compound meeting flammability rating V-0 |

### Package Dimensions — 0201 DFN



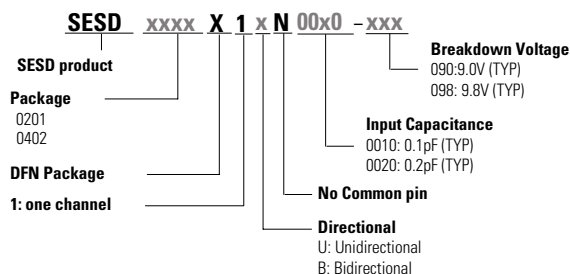
| Symbol | Millimeters |      |      | Inches     |       |       |
|--------|-------------|------|------|------------|-------|-------|
|        | Min         | Typ  | Max  | Min        | Typ   | Max   |
| A      | 0.28        | 0.30 | 0.32 | 0.011      | 0.012 | 0.013 |
| A1     | 0           | -    | 0.05 | 0          | -     | 0.002 |
| A3     | 0.102 ref.  |      |      | 0.004 ref. |       |       |
| D      | 0.25        | 0.30 | 0.35 | 0.010      | 0.012 | 0.014 |
| E      | 0.55        | 0.60 | 0.65 | 0.022      | 0.024 | 0.026 |
| b      | 0.20        | 0.25 | 0.30 | 0.008      | 0.010 | 0.012 |
| L1     | 0.13        | 0.18 | 0.23 | 0.005      | 0.008 | 0.009 |
| L2     | 0.14        | 0.19 | 0.24 | 0.006      | 0.007 | 0.009 |
| e      | 0.356 BSC   |      |      | 0.014 BSC  |       |       |
| M      |             | 0.32 |      |            | 0.013 |       |
| N      |             | 0.24 |      |            | 0.009 |       |
| O      |             | 0.62 |      |            | 0.024 |       |
| P      |             | 0.14 |      |            | 0.006 |       |

### Package Dimensions — 0402 DFN

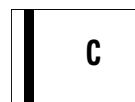


| Symbol | Millimeters |      |      | Inches     |       |       |
|--------|-------------|------|------|------------|-------|-------|
|        | Min         | Typ  | Max  | Min        | Typ   | Max   |
| A      | 0.31        | 0.38 | 0.43 | 0.013      | 0.015 | 0.017 |
| A1     | 0           | -    | 0.05 | 0          | -     | 0.002 |
| A3     | 0.13 ref.   |      |      | 0.005 ref. |       |       |
| D      | 0.55        | 0.60 | 0.65 | 0.022      | 0.024 | 0.026 |
| E      | 0.95        | 1.00 | 1.05 | 0.037      | 0.039 | 0.041 |
| b      | 0.45        | 0.50 | 0.55 | 0.018      | 0.020 | 0.022 |
| L      | 0.20        | 0.25 | 0.30 | 0.008      | 0.010 | 0.012 |
| e      | 0.65 BSC    |      |      | 0.026 BSC  |       |       |
| M      |             | 0.60 |      |            | 0.024 |       |
| N      |             | 0.35 |      |            | 0.014 |       |
| O      |             | 1.00 |      |            | 0.039 |       |
| P      |             | 0.30 |      |            | 0.012 |       |

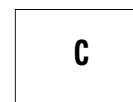
### Part Numbering System



### Part Marking System



Unidirectional

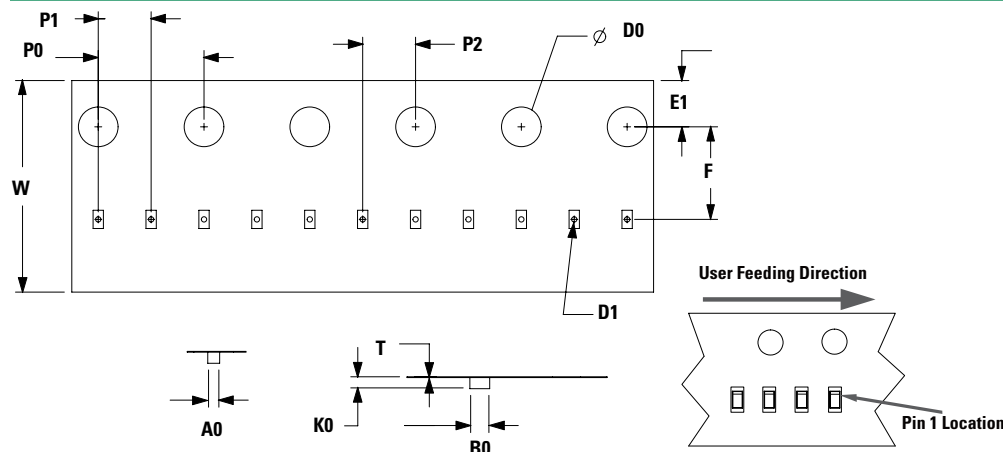


Bidirectional

### Ordering Information

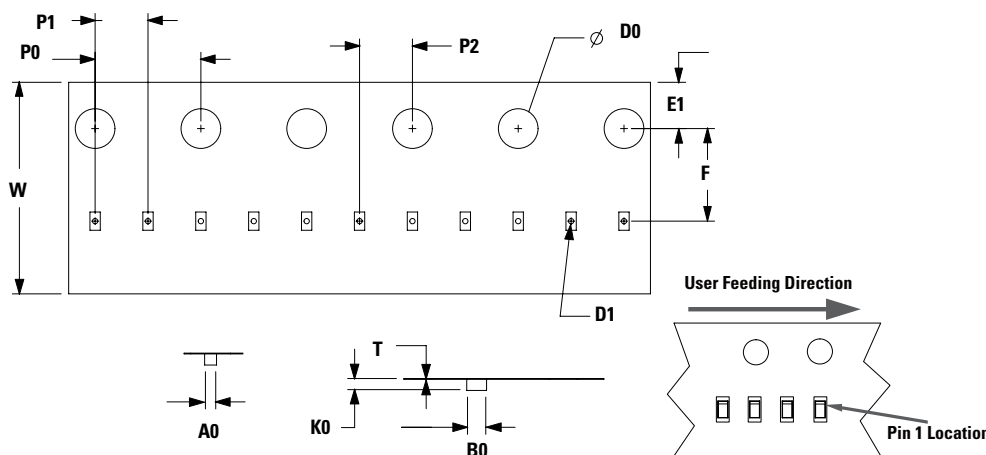
| Part Number           | Package  | Ordering Part Number | Min. Order Qty. |
|-----------------------|----------|----------------------|-----------------|
| SESD0201X1UN-0020-090 | 0201 DFN | RF2192-000           | 75000           |
| SESD0201X1BN-0010-098 | 0201 DFN | RF2193-000           | 75000           |
| SESD0402X1UN-0020-090 | 0402 DFN | RF2943-000           | 50000           |
| SESD0402X1BN-0010-098 | 0402 DFN | RF2945-000           | 50000           |

### Embossed Carrier Tape & Reel Specification — 0201 DFN



| Symbol | Millimeters     |
|--------|-----------------|
| A0     | 0.36+/-0.03     |
| B0     | 0.66+/-0.03     |
| D0     | ø 1.50 +0.10/-0 |
| D1     | ø 0.20 +/- 0.05 |
| E1     | 1.75+/-0.10     |
| F      | 3.50+/-0.05     |
| K0     | 0.33+/-0.03     |
| P0     | 4.00+/-0.10     |
| P1     | 2.00+/-0.10     |
| P2     | 2.00+/-0.05     |
| W      | 8.00+/-0.10     |
| T      | 0.23+/-0.02     |

### Embossed Carrier Tape & Reel Specification — 0402 DFN



| Symbol | Millimeters     |
|--------|-----------------|
| A0     | 0.70+/-0.05     |
| B0     | 1.15+/-0.05     |
| D0     | ø 1.55 + 0.05   |
| D1     | ø 0.40 +/- 0.05 |
| E1     | 1.75+/-0.10     |
| F      | 3.50+/-0.05     |
| K0     | 0.47+/-0.05     |
| P0     | 4.00+/-0.10     |
| P1     | 2.00+/-0.10     |
| P2     | 2.00+/-0.05     |
| W      | 8.00+/-0.10     |
| T      | 0.20+/-0.05     |